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What are the Luminous Compact Blue Galaxies?

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Abstract. Luminous Compact Blue Galaxies (LCBGs) are common at z∼1, contributing significantly to the total star formation rate density. By z∼0, they are a factor of ten rarer. While we know that LCBGs evolve rapidly, we do not know what drives their evolution nor into what types of galaxies they evolve. We present the results of a single-dish HI survey of local LCBGs undertaken to address these questions. Our results indicate that LCBGs have M_{HI} and M_{DYN} consistent with low-mass spirals, but typically exhaust their gas reservoirs in less than 2 Gyr. Overall, the properties of LCBGs are consistent with them evolving into high-mass dwarf elliptical or dwarf irregular galaxies or low-mass, late-type spiral galaxies.

1. Introduction

Luminous Compact Blue Galaxies (LCBGs) are a morphologically and spectroscopically diverse class of galaxies characterized by high luminosity ($M_B < -18.5$), blue color ($B-V < 0.6$) and high surface brightness ($SB_e < 21$ mag arcsec^{-2}). At z∼1, LCBGs are common, contributing 45% of the total star formation rate density, but they evolve rapidly being ten times rarer by z∼0. As such, it is important to understand the role of LCBGs in galaxy formation and evolution. Yet we do not know the basic nature of these galaxies nor their evolutionary fate. They may evolve into dwarf ellipticals (Koo et al. 1994), irregular or low-mass spiral galaxies (Phillips et al. 1997; Guzmán et al. 1998), or bulges of grand-design spirals (Hammer et al. 2001). In order to discriminate between these possibilities, we have begun a multi-wavelength study of the rare, local (D≤200 Mpc) LCBGs. Our sample was selected from the Sloan Digital Sky Survey to match the rest-frame optical properties as LCBGs observed at z∼1. A key component of this study is the measurement of the HI flux and linewidths, allowing determinations of gas content, dynamical masses, and gas depletion timescales. Such measurements constrain the evolutionary possibilities for this class of galaxies. Background and preliminary results have been previously reported by Garland et al. (2004, 2005, 2007); in this proceedings we present the first results from our expanded study of 142 LCBGs.

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2. Observations

Our single-dish HI data come from a number of sources: 57 LCBGs were observed with Arecibo, the Green Bank Telescope (GBT), or Nançay, down to a 5σ M_{HI} detection limit of $2.5\times10^8 M_\odot$. Data on the remaining 85 galaxies come from Meyer et al. (2004), Giovanelli et al. (2005, 2007), Springob et al. (2005), and the GBT HI survey[1]. We reanalyzed all of the spectra; only two galaxies were marginal detections and two were undetected.

3. Conclusions

Our survey found that local LCBGs have a diverse range of HI properties, but that they are generally gas-rich with $M_{HI} \sim 10^{9-10} M_\odot$. They have M_{DYN} within R_{25} of $10^{10-11} M_\odot$. These properties, as well as their mass-to-light and M_{HI}/M_{DYN}, are similar to those of late-type spiral galaxies (Roberts & Haynes 1994). LCBGs have specific star formation rates (SFR/M_{DYN}) similar to HII galaxies, and gas depletion timescales <2 Gyr for the majority of the population. The sizes and HI linewidths of local LCBGs, which should not evolve dramatically, suggest that they will become massive dwarf ellipticals or dwarf irregulars, or late-type spiral galaxies. If the z$\sim$1 LCBGs have similar gas properties, then we can infer that those LCBGs will follow similarly diverse evolutionary paths. This work confirms the results of Garland et al. (2004) with a much larger sample. We have begun a program of mapping a number of these galaxies in HI to search for gas-rich companions, signatures of outflows and recent interactions, as well as to obtain resolved measurements of their rotation curves to derive their dynamical masses. Finally, we are obtaining additional data ranging from the radio to the X-ray regime, to further understand the nature of these galaxies.

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